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(54) IMPROVEMENTS IN OR RELATING TO ROTORS FOR ROTARY ELECTRICAL MACHINES

(71) We, ROBERT BOSCH GMBH., a German Company, of Postfach 50, 7 Stuttgart 1, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to rotors for rotary electrical machines.

One form of known electrical machine has a rotor formed from edgewise-wound sheet magnetic strip or from stacked magnetic lamination, and having slots in which a rotor winding is accommodated.

Numerous electrical machines are already known wherein the slots for accommodating the winding are open, half-closed or closed in structure. The shape of the slots influences both the arrangement of the winding accommodated in the slots and also the shape of the teeth located between the slots.

The slots and the teeth lying therebetween stand in a certain relationship to one another. It must be possible for a winding having a certain cross-section to be accommodated in the slots and above all for this winding to be secured in the slots of a rotor so that it cannot spin out. Moreover, in the small electrical machines the cross-section of the teeth must still be sufficiently large to ensure the necessary magnetic flux. In the case of the relatively expensive windings made of copper, a small winding cross-section suffices, and sufficient space remains between the slots for the associated tooth cross-section.

According to the present invention there is provided a rotor for a rotary electrical machine, formed from edgewise-wound sheet magnetic strip or from stacked magnetic laminations and having slots for accommodating a rotor winding, in which each slot of the rotor, as seen in cross-section perpendicular to the rotor axis, extends substantially radially of said axis and has a radially inner base portion which is a segment of a circle and leads radially outwardly into a trapezoidal portion in which the width of the slot widens radially outwardly of the slot and which merges into a radially outer rectangular portion in which the slot has a substantially constant width and which leads to a radially outer open top.

The present invention can enable the same power characteristic, i.e. the relationship between the winding cross-section which influences the shape of the slots, and the tooth cross-section, to be obtained using more economical aluminium windings, whilst retaining the same number of slots and teeth as in electrical machines having copper windings.

In one embodiment of the invention the slots are disposed such that even in small electrical machines tooth cross-sections which are sufficiently large with respect to adjacent sides of adjacent slots can be achieved by each tooth formed between adjacent slots, as seen in cross-section perpendicular to the rotor axis, having a cross-section with two opposite sides which extend substantially parallel to one another between the trapezoidal portions of the adjacent slots and which diverge from one another in a radially outward direction between the rectangular portions of said adjacent slots.

Drop-in windings, which for starting motors for example can be inserted automatically, can be inserted in slots made in this manner.

So as to enable a winding coil-side to be inserted into a slot base portion having a smaller width than the normal diameter of the coil-side, those parts or coil-sides of the winding which form inner parts of the winding and are to be located in the base and/or trapezoidal portions of the slots are preferably provided with a cross-sectional shape

which matches those portions of the slots. Those parts or coil-sides of the winding which form outer parts of the winding are accommodated in the rectangular outer portions of the slots.

The slots are preferably lined with electrically insulating material.

A substantial advantage of the slots constructed in accordance with the present invention is that relatively inexpensive aluminium can be used for the winding. Although aluminium requires larger conductor cross-sections than relatively more expensive copper, the slots shaped in accordance with the present invention still yield sufficiently large tooth cross-sections to enable the same power characteristics to be achieved as when using copper windings.

Finally, an impregnating agent is preferably applied to the winding inserted into the slots, so as to protect the winding from short circuit to earth and from corrosion. Such impregnation prevents the winding from spinning out of a rotor.

The invention will be further described by way of example with reference to the accompanying drawings illustrating two embodiments of the invention and in which:—

Fig. 1 is a section through a portion of a rotor having slots in each of which two coil-sides are accommodated, the section being taken perpendicularly to the rotor axis, and

Fig. 2 is a similar section through a modification of the rotor of Fig. 1 having slots in each of which four coil-sides are accommodated.

A rotor 1 of a rotary electrical machine is formed from edgewise-wound sheet magnetic strip or from stacked magnetic laminations and has radial slots 2 which are lined with electrically insulating paper 3. A preformed winding 4 is accommodated in the slots 2. Each slot has an inner base portion which is a segment of a circle and leads into a trapezoidal portion 6 in which the width of the slot widens radially outwardly of the slot and merges into an open radially outer rectangular portion 7 whose sides run parallel to one another so that this portion of the slot has substantially constant width and leads to a radially outer open top.

Between adjacent slots 2 a tooth 9 is formed, which in the region between the trapezoidal portions 6 of the adjacent slots has parallel sides 10, and which widens radially outwardly in the region of the rectangular portions 7 of the adjacent slots 2. Each tooth thus has a cross-section which comprises a rectangular portion and a trapezoidal portion, which adjoins the former portion towards the edge or open tops of the slots.

The winding 4 comprises individual parts of the winding in the form of a coil. Prior to the dropping in of the winding into the slots 2, the coil portions or coil-sides 11, which serve as the inner parts of the winding are so pressed into shape that these coil-sides 11 abut against the bases 5 of the slots and substantially fill the trapezoidal portions 6 of the slots 2. Coil portions or coil-sides 12, which serve as the outer parts of the winding, are dropped into the rectangular portion 7 of the slots 2. This insertion can be effected under a certain degree of compression which together with an impregnating agent applied to the winding 4 can restrain the winding 4 from spinning out of the rotor 1.

The winding 4 is composed of aluminium wire having a circular cross section. During insertion of the outer coil-sides 12, the twisting of the wire is per se no longer significant, since the round wire is pressed past the insulating paper 3 into the slots 2 without damaging the insulating paper 3.

A modification of the rotor 1 of Fig. 1 is shown in Fig. 2. A portion of a rotor 13 is shown here which has slots 14 of which bases 15 are disposed at a short distance from one another. However, the width of each tooth 16 in the region of trapezoidal portions 17 of the slots 14 is the same as that of each tooth 9 of Fig. 1 and it widens out in the region of the rectangular portions 18 of the slots 14. The actual slots 14 are narrower than the slots 2 and in the rectangular portions 18 have sides 19 which run parallel to one another. A winding 20 is inserted into the slots 14, which winding is composed of winding parts each comprising two coil-sides. Each coil portion comprising two coil-sides 21 which serves as the inner part is likewise so shaped prior to dropping in that it substantially fills a base 15 of a slot and at least the trapezoidal portion 17 of a slot. A coil portion 22 which serves as an outer part and comprises two coil-sides is dropped into a slot 14 in the same manner as the coil portion 12 of Fig. 1 which comprises a single coil-side.

The slots may also be modified so as to permit the insertion of winding parts having more than two coil-sides.

WHAT WE CLAIM IS:—

1. A rotor for a rotary electrical machine, formed from edgewise-wound sheet magnetic strip or from stacked magnetic laminations and having slots for accommodating a rotor winding, in which each slot of the rotor, as seen in cross-section perpendicular to the rotor axis, extends substantially radially of said axis and has a radially inner base portion which is a segment of a circle and leads radially outwardly into a trapezoidal portion in which the width of the slot widens radially outwardly of the slot and

which merges into a radially outer rectangular portion in which the slot has substantially constant width and which leads to a radially outer open top.

2. A rotor as claimed in claim 1, in which teeth formed between adjacent said slots, as seen in cross-section perpendicular to the rotor axis, each have a cross-section with two opposite sides which extend substantially parallel to one another between the trapezoidal portions of the adjacent slots and which diverge from one another in a radially outward direction between the rectangular portions of the said adjacent slots.

3. A rotor as claimed in claim 1 or 2, in which each slot is lined with electrically insulating material.

4. A rotor as claimed in claim 1, 2 or 3, having a preformed coil winding accommodated in its slots.

5. A rotor as claimed in claim 4, in which that part of the coil winding which is received in the base portion and in the trapezoidal portion of each slot has a cross-sectional shape which matches said cross-sectional shape of the base and trapezoidal portions of the slot.

6. A rotor as claimed in claim 5, in which that part of the coil winding which is received in the rectangular portion of each slot has a substantially circular cross-section.

7. A rotor as claimed in claim 4, 5 or 6, in which each slot accommodates two coil-sides.

8. A rotor as claimed in claim 4, 5 or 6, in which each slot accommodates four coil-sides.

9. A rotor as claimed in any of claims 4 to 8, in which the winding is composed of aluminium.

10. A rotor as claimed in any of claims 4 to 9, in which an impregnating agent is applied to the winding in the slots.

11. A rotor for a rotary electrical machine, constructed and arranged and adapted to be operated substantially as hereinbefore particularly described with reference to and as illustrated in Fig. 1 or Fig. 2 of the accompanying drawings.

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1 496 176 COMPLETE SPECIFICATION
1 SHEET This drawing is a reproduction of the Original on a reduced scale.

Fig. 1

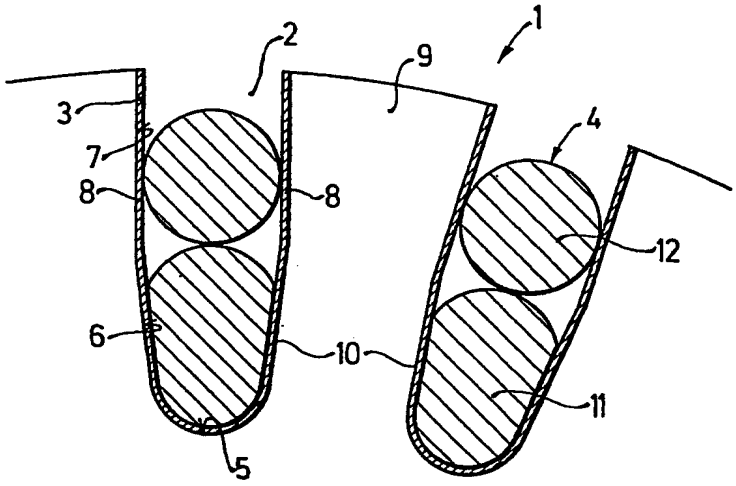

Fig. 2